AGRICULTURAL Research

AUGUST 1956

EXPLORATION
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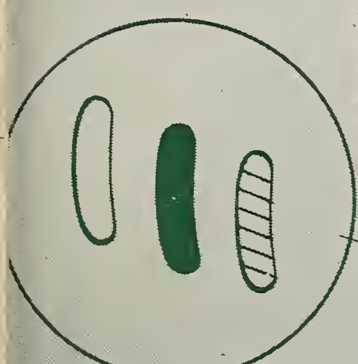

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UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL
Research

Vol. 5—August 1956—No. 2

CONTENTS

Managing Editor: J. F. Silbaugh. Assistant Editor: J. R. Deatherage. Contributors to this issue: G. F. Snell, C. E. Gapen, P. K. Schultz, M. S. Peter, E. Evers.

For all

Agriculture is a meeting place for the sciences—more of them, perhaps, than in any other single pursuit. The reasons lie in two aspects of modern agricultural research:

One aspect is our high degree of specialization. A good scientist strives to make himself expert in a narrow field and, at the same time, acquaint himself with related fields.

The other aspect is our policy of attacking a problem on a broad front. The greatest progress is made when teams of workers turn diverse specialties to a common problem.

The effect of these two characteristics is illustrated by one of the most familiar research products—hybrid corn.

Fundamental work was started early this century by geneticists primarily interested in extending our knowledge of heredity. In the 1930's, the new corn began to sweep the country.

These hybrids were much better adapted to mechanical harvesting than the open-pollinated varieties, and breeders were able to improve on this character. So pickers followed hybrids into our fields. The picker-sheller came into wide use once engineers developed principles for more efficient dryers.

Chemists' work on composition showed that corn is a relatively cheap and abundant source of protein. It has many uses—in varnish, paper sizing, asphaltic compositions, and fiber, to name a few—and shows promise of numerous others.

There are exciting research opportunities in the improvement and utilization of corn today. We should be able to improve plant vigor by bringing together the proper combination of genes. We may find sources of disease resistance in germ plasm assembled by plant explorers, and in the mutations produced in radiation studies. New tools and techniques are opening vistas on plant-soils relationships. Scientists may produce new hybrids with a higher proportion of the biologically balanced germ protein. It's even possible that fundamental research on corn protein will give us new light on the sources of energy involved in the synthesis of protein.

Those are only a few of the opportunities in one field. But that's enough to suggest the limitless future in all agricultural research for students of every discipline.

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AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

"for outstanding performance"

AWARDS PRESENTED BY SECRETARY BENSON INCLUDE SEVERAL RESEARCHERS AND UNITS

P. A. WELLS

M. R. CLARKSON

SECRETARY Ezra Taft Benson presented 28 individual and 5 work-unit awards to Agricultural Research Service employees for outstanding performance, at USDA's ninth annual Honor Awards Ceremony on June 5.

A total of 155 individual and 20 work-unit awards were made to USDA personnel throughout the country.

ARS winners of the Distinguished Service Award:

M. R. Clarkson, ARS Deputy Administrator for Regulatory Programs, for skillful public administration and for solving difficult problems in protecting the livestock industry from foot-and-mouth and other diseases.

Eastern Utilization Research Branch—P. A. Wells, Chief, for sustained leadership in directing and coordinating research leading to substantially increased utilization of many abundant agricultural commodities.

ARS winners of the Superior Service Award:

Eastern Utilization Research Branch—W. C. Ault, for research on chemistry of fats resulting in major scientific advances and increased utilization.

R. C. Calhoun, Jr., for developing new or expanded uses for agricultural commodities through design and construction of new and improved scientific equipment.

Production Economics Research Branch—G. T. Barton, for designing measures of changes in farm output, interpreting past and future changes in farm output, and analyzing contributing factors and policy implications.

E. L. Sauer, for conducting, interpreting, and reporting research on economics of soil and water conservation, influencing farmers to adopt good practices.

Plant Pest Control Branch—H. L. Blaisdell, for contributions to forest-insect pest control through leadership in the development of procedures for controlling the gypsy-moth (Agr. Res., October 1954, p. 13).

J. N. Crisler, for securing cooperation of Mexican authorities in suppression of pink-bollworm infestation in northeastern Mexico, to protect our cotton crop.

I. Granek, for discovering a method of distinguishing the golden nematode from the tobacco cyst nematode, alleviating a complicated and costly regulatory problem.

V. A. Johnson, for securing public compliance with plant-quarantine requirements, and for developing safe, effective control techniques and low-cost methods of certification in the Japanese-beetle control program.

Horticultural Crops Research Branch—Edith K. Cash, for developing a world-wide index to fungus names used internationally as a basis for nomenclature decisions, and for research on fungi important to agriculture.

Entomology Research Branch—F. F. Dicke, for research contributing to development of insect resistance in corn now used in improvement work (June 1955, p. 3).

L. S. Jones and N. S. Wilson, for research showing destructive mosaic virus disease of peaches is transmitted by a microscopic mite, thus facilitating the development of practical virus control measures.

R. C. Roark, for leadership in developing and improving use of chemical control methods for insect pests (April 1955, p. 15; January 1956, p. 16).

Northern Utilization Research Branch—H. J. Dutton, for pioneering experimental techniques for chemical research, and for advances in the field of lipids.

W. H. Meyers, for effectiveness in planning, scheduling, and supervising the maintenance of buildings and grounds at the Northern Utilization Research Branch.

F. R. Senti, for research leading to better fundamental understanding of properties and uses of crop constituents, through application of complex physical methods.

C. L. Mehltretter, for research leading to chemical conversion of cereal-grain carbohydrates to new products, a development significant in theoretical chemistry and resulting in improved utilization of grains.

Aircraft and Special Equipment Center—A. Gieser, for improvements in safety and performance of aerial spraying, thus contributing to the protection and management of mountainous forests and rangelands.

Southern Utilization Research Branch—T. H. Hopper, for research leading to new and extended crop uses.

Plant Quarantine Branch—Annie L. Lohr, for planning and preparing a book, "Plant Diseases in Color,"

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illustrating plant-disease symptomology, for use as an inservice training tool by plant-quarantine inspectors.

Field Crops Research Branch—F. V. OWEN, for fundamental genetics research on sugar beets leading to utilization of male sterility in producing hybrids, incorporation of monogerm into commercial varieties, and breeding of improved varieties (June 1956, p. 6).

R. H. PEEBLES (deceased), for leadership in the field of cotton agronomy in Arizona, for contributions in breeding American-Egyptian cottons, and maintenance of the industry in the United States (March 1956, p. 3).

H. A. SCHOTH, for contributing to the development of the Pacific Northwest grass and legume seed industry, and for research leading to improved varieties.

E. E. HARTWIG, for research leading to the development of superior soybean varieties and cultural practices in the southeastern United States (June 1954, p. 12).

Soil and Water Conservation Research Branch—J. VICENTE-CHANDLER, for leadership in securing acceptance of research essential to improvement of agriculture in the humid mountainous region of Puerto Rico.

Animal and Poultry Husbandry Research Branch—B. WINTON, for administration of a research program for lymphomatosis control and for contributing to improved poultry production (June 1954, p. 4; April 1955, p. 6).

ARS work-units cited for Superior Service:

Southern Utilization Research Branch—COTTON ACETYLATION RESEARCH GROUP, for development of a partially acetylated cotton with excellent heat and rot resistance, thus opening new markets for cotton, and for cooperative research with industry for commercial production.

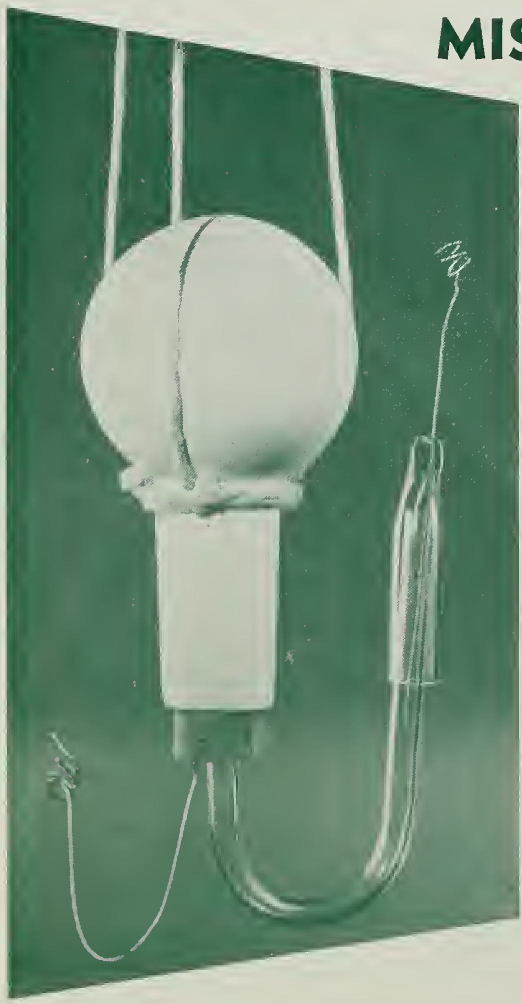
RESEARCH GROUP FOR THE DEVELOPMENT OF FILTRATION-EXTRACTION PROCESS, for improving extraction of oil-bearing materials through development of the widely applicable filtration-extraction process, contributing materially to oilseed economy (May 1956, p. 5).

Eastern Utilization Research Branch—FUNGAL AMYLASE TEAM, for developing the fungal amylase process for more economical production of ethyl alcohol from grains.

PLANT-QUARANTINE TRAINING CENTER—for developing a center and curricula to train foreign and United States plant-quarantine workers, for better protection against international spread of plant pests.

Western Utilization Research Branch—PRECOOKED FROZEN FOOD RESEARCH GROUP, for discovering practical means of controlling texture-change defects in thickened, frozen, and canned foods, through use of a new thickening agent, waxy-rice flour (April 1954, p. 11). ☆

MIST CONTROL MADE EASY



■ WITH EFFECTIVE second thoughts, two USDA scientists have improved a device for controlling and maintaining moisture in greenhouse propagating rooms to insure better results in growing tree cuttings. Simply made from low-cost materials, the device may prove valuable to many researchers and is likely to find more general use as a watering control for lawns and other turfs. It is already attracting the attention of manufacturers.

Because of its relative simplicity (it is made up of a small porous clay globe, a few inches of small-diameter glass tubing, a foot or so of copper or nichrome wire, and a length of insulated wire for suspending it) the new device has proved reliable and long-lasting. Its action is keyed to the moisture conditions that surround the plants. It doesn't depend on a person's capricious watchfulness.

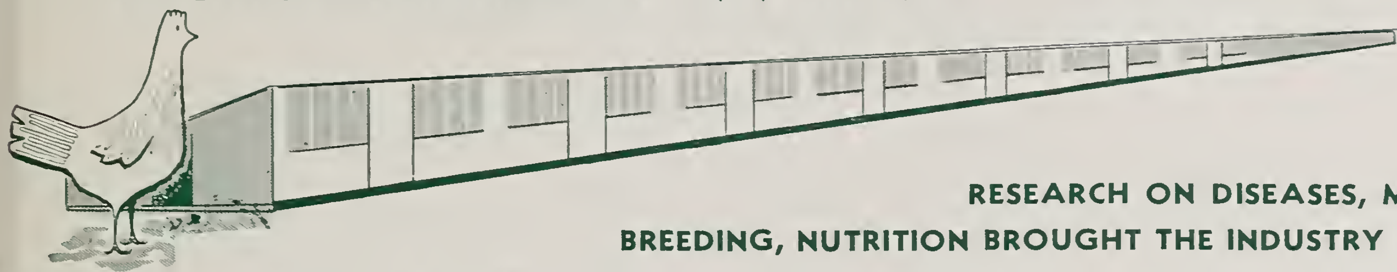
The ability of clay to absorb and give off moisture readily has been exploited by ARS plant pathologist C. May and plant physiologist E. Hacskaylo in developing this device.

The clay globe is known to scientists as a Livingston atmometer. The hookup of the other parts is new. During misting, water collecting inside the globe fills the glass U-tube, which also contains one of the wires leading to the switch of the mist machine. When water reaches high enough in the tube to contact the other wire, the circuit is completed and the mist machine stopped. When evaporation from the globe drops the water to a level low enough to break the circuit, misting begins again.

The device has helped grow a high percentage of strong, well-rooted cuttings, reducing the unit cost of controllers and speeding research. ☆

poultry

How the Broiler Business Works



RESEARCH ON DISEASES, MANAGEMENT, BREEDING, NUTRITION BROUGHT THE INDUSTRY NEW FREEDOM

A LAW that's not in the statutes dominates the United States broiler industry nowadays. It's the law of diminishing returns, a cornerstone of economic theory. Many groups are affected—broilermen, suppliers, the trade, consumers.

The role of this economic law in regulating the size of an individual broilerman's business, and ultimately the output of the industry, is pointed up in an economic study by USDA. Equally interesting is the evidence that technological obstacles had long kept our flock sizes so small that broiler raisers had little range for planning until recent years.

First, a word about those problems and the technological revolution that set our broiler growers free.

The industry was handicapped by diseases and parasites, by the slow-growing chickens that were in production, by low-energy feeds being used, and by the cumbersome way broiler houses were organized and work done. Federal, State, and industry research over many years had laid the basis for improvements.

Demand for more poultry meat during World War II started the ball rolling. Broilermen increased flock size. Then, lacking enough labor qualified to handle poultry, they devised labor-saving equipment—notably, automatic feeders and waterers. More efficient houses and work methods were planned to get the work done. Those things figure in the low labor requirement for broilers today.

Great strides had been made against the epidemic killers, pullorum disease and fowl pox, through the Federal-State program for testing flocks and certifying those found disease free. But the big cleanup of these killers came after the war. At about the same time, sanitation and better house design were controlling respiratory and intestinal diseases. That made big broiler flocks practical.

In the 1950's, breeders began supplying hatcheries from fast-growing strains of chickens and hybrids, discovered through the Federal-State National Poultry Improvement Plan and popularized by a national contest. Then, at the suggestion of Connecticut scientists, feed mixers started using more corn in their formulas (and subsequently some surplus animal fats and other growth boosters) to give more oomph per bite of feed. These advances mean chickens hit market weight 15 to 30 percent faster.

To encourage business expansion, dealers have been extending credit to cover chicks, feed, and supplies. Dependable poultrymen with little more to offer than a chicken house and their own labor often are in business now with a fixed investment as low as 2 or 3 percent of total cost—one of the lowest ratios in farming.

To ARS economists P. L. Hansen and R. L. Mighell, who made the economic study, the recent changes in broiler raising give a producer an exceptionally free hand in planning his operations. Here's the way the principle of diminishing returns now operates in three typical situations:

In some systems of farming, labor is available—that is, it's not needed for higher-priority work—for only about 3 months of the year. Broilers are raised as a sideline to use the labor. That limits the grower to one batch of chickens a year. Housing or labor may limit the size of the flock, but once the lot is started, the relation between feed and broiler prices will largely determine the best market weight. Hansen and Mighell found that average birds raised on $5 feed will return the most income above direct cost if sold at $3\frac{3}{4}$ pounds at a 25-cent price, but at $4\frac{1}{4}$ pounds if the price is 30 cents a pound.

Suppose a grower is operating the year round and with 2 weeks for preparation between lots. Then the most profitable finish weight depends on which factor, labor or space, is more limiting. If labor is limiting, it will pay to finish birds heavy at $3\frac{1}{4}$ to $3\frac{1}{2}$ pounds, depending on whether the price is 25 or 30 cents a pound. That takes 75 to 80 days of feeding and allows 4 batches a year.

Price also makes a difference if space rather than labor sets the limit—but it will pay to finish birds light. With a 25-cent broiler market, a $2\frac{1}{2}$-pound finish gives the highest return for the year. But if broilers were priced at 30 cents, it would pay the grower to sell his birds a little lighter—at $2\frac{1}{4}$ pounds. Then he could start a sixth batch of chicks. ☆

MAKING

NATURAL wool has many excellent and desirable properties—such as resiliency and wrinkle resistance. USDA wool scientists are taking full advantage of these qualities and, at the same time, searching for ways to cut down on wool's limitations and to increase its usefulness.

Work is progressing, for example, on a wool fabric that would retain creases and pleats to a higher degree. Researchers are making wool more resistant to felting shrinkage during laundering. On the other hand, they are making wool softer to permit easier felting in making certain heavy fabrics. They are improving bleaching methods without damaging fiber quality. They are devising ways to make wool more resistant to soil. And they are treating wool with chemicals to give it much greater resistance to moths and micro-organisms.

Wool utilization research is centered at the ARS Western Utilization Research Branch, Albany, Calif. Basic aim of this work is to give wool a wider range of qualities—and improved qualities—for many purposes.

A major concern of researchers here is the development of practical methods for dealing with off-color wools and the discoloration of wool fabrics. Scientists are studying the chemistry of the discolorations involved to provide a firm basis for developing ways to prevent them.

This problem has become more acute with increasing demand for pastel fabrics. The unscoured (uncleaned) wool frequently yellows on long storage. Off-color persists after the wool has been well scoured, and it is difficult to remove by bleaching.

ARS researchers found that urocanic acid may be one of the factors responsible for yellowing of unscoured wool. This acid in pure form has just been isolated from wool suint—the perspiration residues from raw wool. It is also a constituent of human perspiration, and the problem of wool fabric yellowing by perspiration is generally recognized. Efforts are being made to identify the other suint components that are responsible for this type of discoloration.

Another discoloration problem is the gradual yellowing and darkening of light-colored wool fabrics with normal use. One of the probable causes is exposure of the fabric to light. This exposure not only yellows the fabric, but also decreases its tensile strength and elastic recovery. The yellow colors are hard—sometimes impossible—to remove by washing and extremely difficult even to bleach out.

Other chemical modifications may help to develop wool with new and practical importance. Treatment with propiolactone, for example, brings about a chemical reaction resulting in softening of the fibers. This has practical interest for felting studies; treated fibers are more easily felted than untreated fibers.

Inside the Wool Fiber

■ BASIC AND IMPORTANT work is in progress to determine the structure of the wool fiber—what it's made of and how it's put together.

The very heart of the wool fiber consists of tiny, thread-like molecules. Researchers are finding out how these threads coil and uncoil, how they stick together, how their properties may be changed by treatment with chemicals. This knowledge is basic in developing better scouring, bleaching, and dyeing methods. It also provides the basis for developing wool with much better resistance to shrinkage, yellowing, and abrasion.

The fiber is a highly complex chemical structure, covered with a sheath of scales, which superficially suggest shingles on a roof. The scales surround a core of tightly packed elongated spindle cells. The black spots in the center of the cells are chemical remnants of what were once nuclei of living cells. These spots show only with application of special stains.

Scientists have found that the elongated cells consist of bundles of

WOOL BETTER

Research on wool promises to extend this fiber's range of qualities

Chlorine and resin impart resistance to shrinkage in laundering; DDT and silicofluoride impart resistance to moths and micro-organisms. These treatments often accomplish one aim at the expense of some desirable property. Consequently, researchers are trying to develop low-cost treatments that give desirable properties to wool without injurious effects.

Another problem of importance is the harshening and weakening effects of dyeing upon wool, caused by contact with the acids during the dyeing process. Scientists are developing wool that is resistant to acidic and alkaline (caustic) solutions normally used in dyeing. This will permit more effective dyeing procedures and the use of certain brilliant shades, now impossible to achieve without seriously injuring the fibers.

A new approach to the evaluation of "handle"—now judged subjectively by feel—is being developed. This is the sound analyzer or "rustleometer." Handle is the way the fabric feels to the wool expert, from which he can judge its many quality characteristics—drape, softness, warmth, texture, and others. Finishing procedures and agents customarily applied to wool to give it desirable qualities often impair handle.

The rustleometer analyzes the sound produced by fabrics rubbed together. A calibrated microphone picks up the sound. The sound pattern gives a direct index of fabric handle. Scientists hope this instrument, or a more refined model, may assist the measurement of handle by exact physical measurements. They also foresee its utilization in comparing qualities of unprocessed (natural) wool. ☆

threads cemented together and lying mostly in the lengthwise direction of the cells. Researchers report that the scales seem to consist of threads lying in random fashion much like the fibers in leather. Covering the outside of the scales is the epicuticle—a smooth, thin, tough, water-repellent, and chemical-resistant membrane—which gives wool its desirable water-shedding quality. Because this membrane is porous to water vapor, however, it will permit the vapor to pass through to become absorbed on the inside of the fiber. This gives wool its equally desirable and much sought moisture-absorbing quality.

Threads of the elongated cells and scales can be subdivided into finer threads. These, in turn, consist of the coiled, threadlike molecules that researchers are busy studying.

These molecular coils, which give wool its characteristic resiliency, join into networks and bundles of networks. It is these networks, together with a limited amount of protein serving as cementing material, that make up the component parts (scales, spindle cells) of the fiber.

The molecular coils are protein molecules. All parts of the wool fiber are constructed of protein molecules called keratin; all protein molecules are built from chemical units called amino acids. In wool, about 20 different kinds of these amino acids are joined together in an unknown order to form the molecular threads.

Protein thread molecules have been isolated and chemically analyzed in recent experiments here and abroad, enabling a more complete description of wool-fiber behavior. Various experimenters have used X-rays, electrons, and infra-red light to determine the nature of the coiling of these molecules. Scientists have also characterized the energy of coiling and uncoiling of molecules in relation to the mechanical properties of the wool fiber. Such data helps to determine the elastic properties of wool. This information, in turn, helps in the design and modification of our textile machinery. It may also have considerable application in the engineering of various new types of fabrics.

One of the chemical areas in wool fiber that is especially susceptible to destruction and weakening during processing is the sulfur bond.

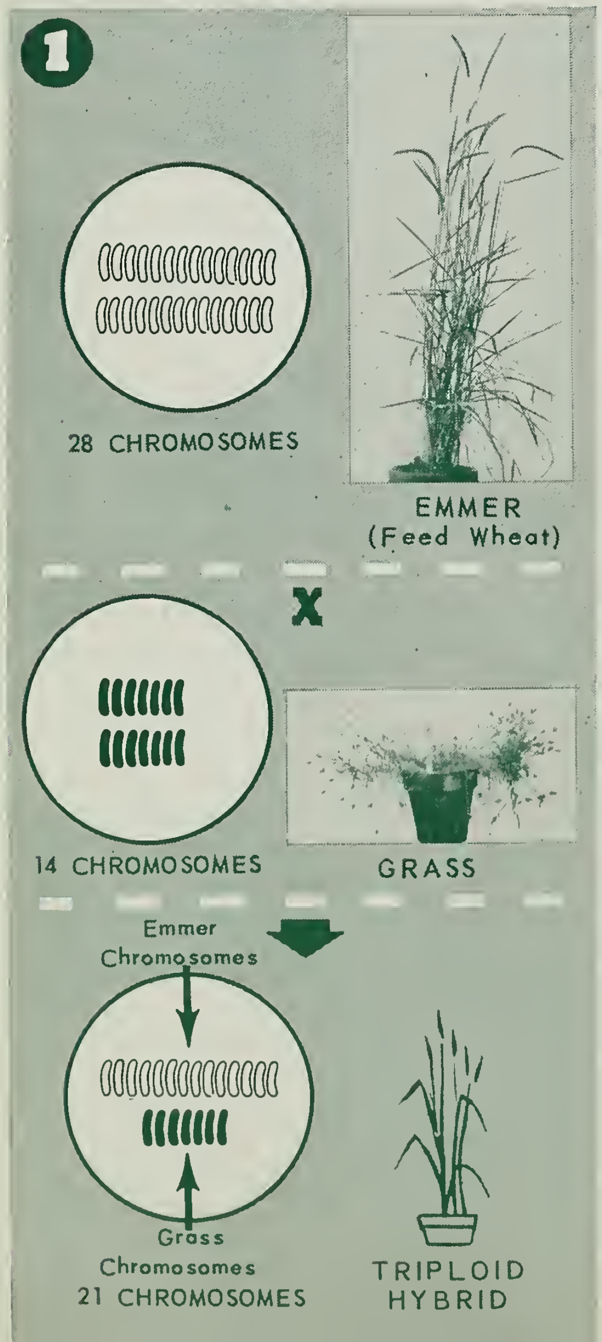
This bond consists of two sulfur atoms. It is the principal linkage connecting the molecular threads into networks. When the bond is broken by hot water, bleaches, and alkaline conditions, wool becomes weak and loses its long-range elastic properties. It is possible to increase the stability of sulfur links by modification of the atoms in their immediate vicinity. Another approach to this problem is to change the sulfur link itself.

USDA researchers are building new types of cross links in wool by replacing the sulfur bond with more stable compounds, using some newly synthesized reagents. Wool thus treated are more stable in alkali, more resistant to reducing agents, and to oxidizing agents in bleaching.

Studies on other aspects of wool processing are also underway. ☆

RESISTANCE-
FROM GRASS TO WHEAT

Years of patient work have brought to wheat the leaf-rust resistance found in a wild relative



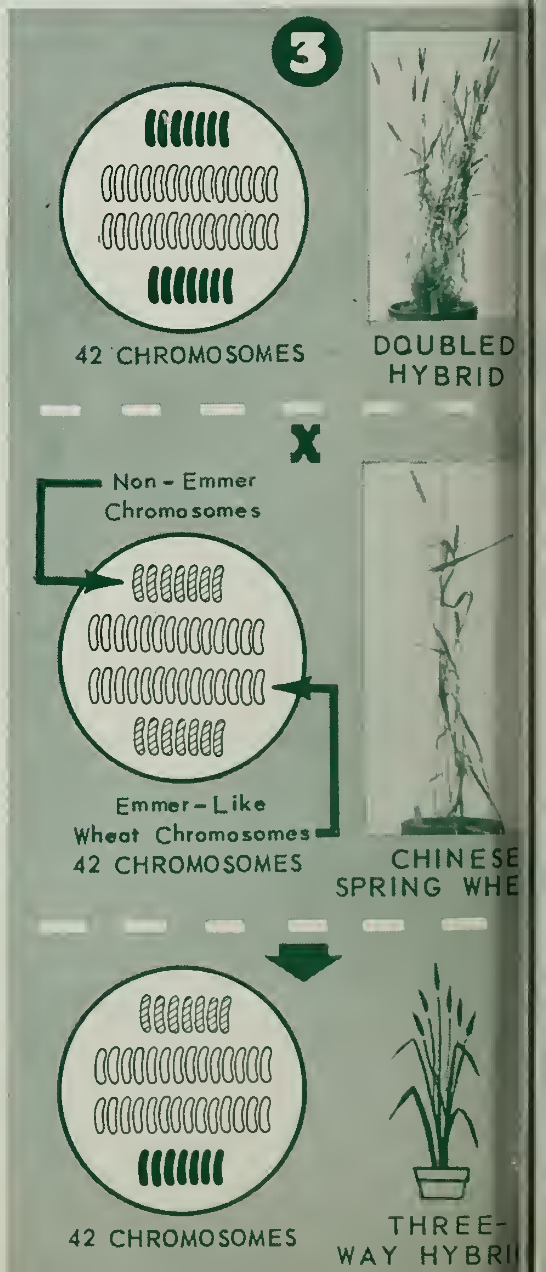
LEAF-RUST resistance found in a wild grass has been bred into wheat, gaining an old objective.

After years of cooperative research by USDA and the Missouri experiment station, a potent gene for leaf-rust resistance has been fixed into Chinese Spring variety of common wheat. The gene gives resistance to all 22 rust races for which it has been tested.

Very few varieties of common wheat are highly resistant to any of the 22 rust races. Some of the related wild grasses, however, are practically immune to this disease. One of these wild grasses is *Aegilops umbellulata,* a native of the Mediterranean areas.

That grass, however, has only 2 sets of 7 chromosomes—the tiny rod-like carriers of heredity found in plant cells—whereas common wheat has 6 sets of 7. Because of this difference, scientists have been unable to make a direct cross between these two species.

ARS plant breeder E. R. Sears brought the distant relatives together by indirect means (Step 1).



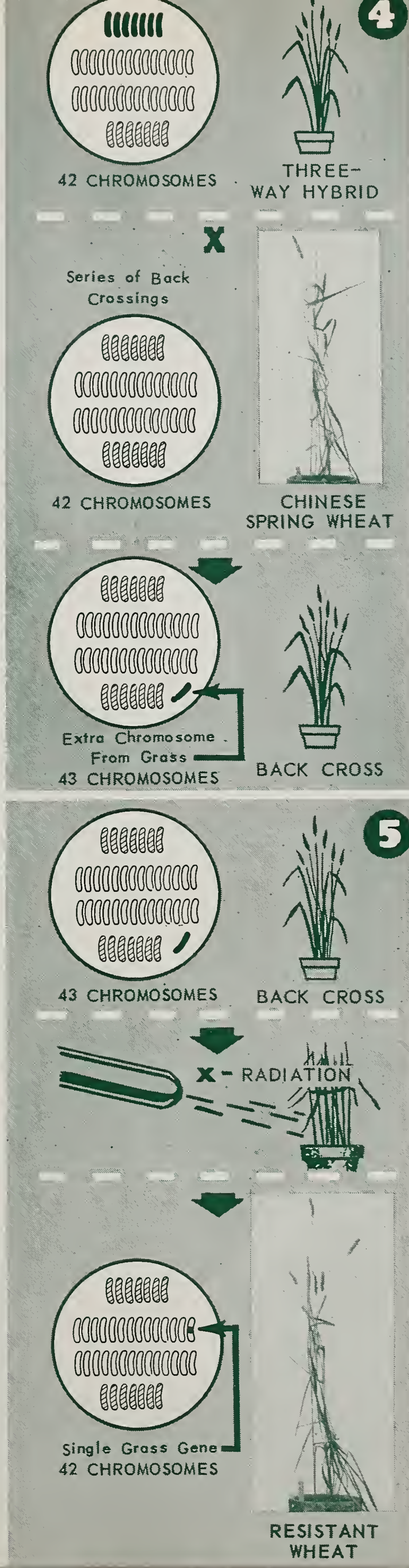
He crossed the wild grass, which has 2 sets of chromosomes, with emmer, a feed-grain crop that's related to wheat but has 4 sets of chromosomes. This produced a hybrid with 3 sets of chromosomes. That's one-half the number of chromosomes in common wheat.

This hybrid plant was highly sterile, so Sears treated it with the drug colchicine and caused a doubling of the chromosome number (Step 2). In this way he obtained a fully fertile plant, part wild grass and part emmer, which had 42 chromosomes, the same number that common wheat has.

Sears then proceeded to cross this synthetic plant with the Chinese Spring common wheat, producing a 3-way hybrid (Step 3).

Although Sears' doubled grass-emmer hybrid had the same number of chromosomes as common wheat, only 14 of them—those from emmer—were closely enough related to wheat chromosomes to pair with them in a cross. The 7 chromosomes from the grass were different from any present in the wheat. This led to difficulties when it was time for the 3-way hybrid to form reproductive cells.

In any ordinary plant, each different chromosome occurs in pairs, except during certain reproductive stages. In the formation of reproductive cells the chromosome number is reduced in an orderly way from 42 to 21, each cell receiving one of each kind of chromosome. In Sears' 3-way hybrid, however, 14 of the 42 chromosomes were without mates—the 7 from the grass ancestor and 7 from Chinese Spring wheat. Instead of behaving regularly, these 14 could only pass at random to one reproductive cell or another during cell division. As a result some cells received no grass chromosomes and others got as many as 6.



Sears backcrossed these grass-emmer-wheat hybrids to Chinese Spring wheat (Step 4) and studied the chromosomes of those offspring that were resistant to leaf rust. In the second backcross generation, a 43-chromosome plant was obtained which was resistant to leaf rust but in most ways resembled Chinese Spring wheat. Unlike Chinese Spring wheat, however, it had certain undesirable characteristics—particularly, low fertility and lack of vigor. Sears found that one of the chromosomes, and only one in this plant, was from the grass *Aegilops*. Offspring of the plant that had the full 21 pairs of wheat chromosomes plus this one *Aegilops* chromosome were resistant, whereas all others were fully susceptible. In addition to the rust resistance factor, however, the undesirable characteristics mentioned unfortunately were also tied up with that one *Aegilops* chromosome.

To overcome the undesirable features, Sears X-rayed the unique plants before flowering and applied the pollen that was subsequently formed to normal wheat plants (Step 5). This X-raying had caused individual chromosomes to break up and exchange genes (heredity units). X-raying frequently causes such exchanges.

Of the 6,091 offspring produced following X-raying, at least 17 had retained the rust resistance but appeared to have *only part* of the grass chromosome carrying resistance. One plant had so few of the undesirable grass features that it had apparently picked up only a very small section from the middle of the grass chromosome—the gene for rust resistance and little else. This one had near immunity to all 22 races with which it was tested and no other evident character from the grass. ☆

SUGARCANE GETS A BREAK

New stock and new facilities point to the end of a serious disease

USDA's world collection of sugarcane at Canal Point, Fla., is about to pay important new dividends.

In this bank, among thousands of cultivated and wild sugarcanes from around the world, have been found 4 varieties of breeding cane, 1 immune and 3 ranging from resistant to immune to ratoon stunting disease.

The finding of these varieties in the Canal Point collection by ARS pathologist E. H. Todd gives Federal and State plant breeders their first opportunity to develop commercial varieties that are immune or resistant to this destructive virus disease.

Now, the only means of control is the slow and relatively costly heat treatment of seed cane. Heat kills the virus and thus provides a source of disease-free stock. But this method is in use under Federal-State auspices in southern sugarcane-growing States only as a stop-gap plan awaiting hoped-for development of resistant or immune sugarcane varieties.

Our present prospect of developing such new varieties depends on these four clones: C. P. 1, B. 39246, Ba. 11569, and Cl. 41–70. The first has strongly indicated complete immunity under tests that knocked many other clones out of the running. The last three have shown reactions ranging from resistance to immunity. C. P. 1 is from one of the very earliest crosses made by USDA in 1922 from foreign stock. B. 39246 came to Canal Point in 1949 from Barbados, Ba. 11569 from Puerto Rico in 1925. Cl. 4170 was developed in 1949 by B. A. Bourne, of the U. S. Sugar Corporation, at Clewiston, Fla.

Until Todd tested them, however, their immunity or resistance to ratoon stunting disease was unknown.

Steps to breed satisfactory commercial varieties have already been taken. Out of the initial attempt has come one seed-bearing panicle from a cross between C. P. 1 and a commercial variety. This is expected to produce about 1,000 seedlings. Among them may be some that will have the desirable characteristics of commercial cane and the immunity of C. P. 1. Nine crosses have been made with Cl. 41–70 as one parent.

Canal Point scientists count themselves fortunate to have produced a seed-bearing panicle in their first try at crossing the immune C. P. 1. Since the two plants used in the cross don't ordinarily flower at the same time, simultaneous flowering had to be induced by special manual control of temperature and light.

With these difficulties in mind, researchers are carrying out plans for new and improved facilities at the station to provide for simultaneous flowering of canes of different varieties. These improvements are speeding production of viable seed panicles from crosses of the resistant and immune clones with commercial varieties. More viable seed will mean greater possibility of finding seedlings that incorporate disease resistance or immunity along with desirable commercial characteristics.

One new facility is a specially designed high-ceiling greenhouse. This houses canes grown to maturity at heights of 12 to 14 feet or more.

The photoperiod laboratory, similar in design to the new greenhouse, has been refitted with better means to control light and temperature.

With these two facilities, sugarcane plants to be used in crossing can be grown under the exact conditions that different varieties require for flowering and producing seed.

Under normal field conditions in this country, sugarcane rarely flow-

1. Sugarcane flowers and produces seed (note panicles) under proper conditions of temperature and light—seldom the case in this country. Here, sugarcane rarely forms seed unless the growing conditions are controlled.

2. Truckload of different crosses is ready to be placed in Canal Point photoperiod laboratory. Light, temperature, and humidity can be controlled to induce simultaneous flowering of plants to be used in crossing.

3. The plant can be grown to full maturity in this special new greenhouse at U. S. Sugar Plant Field Station, Canal Point, Fla. This permits flowering of various crosses and production of panicles, or seed heads.

ers. This is because the growing season is limited by low temperatures and short days in the fall, when cane normally flowers and produces seed.

Ratoon stunting disease was unknown until 1950. when it was discovered in Australia. It was found a little later in Louisiana and many foreign countries. Even then, it was not immediately suspected of being the cause of the slow dropoff in yields of cane varieties resistant to many diseases (AGR. RES., July 1955, p. 7).

Before ratoon stunting disease was known to be the cause of these production declines, the only means of maintaining output was the use of new varieties developed by plant breeders from Canal Point plasma. These new canes were neither resistant nor immune—they merely produced well for a few years until ratoon stunting disease caught up with them. Presumably, this disease was responsible, in less than 25 years, for 5 or 6 almost complete varietal changes of the canes in commercial use.

Canal Point is again the focal point of attack against this serious disease. As seed panicles are produced there from new crosses, seedlings will also be grown and tested under Federal-State cooperation at USDA's sugarcane stations at Houma, La., Cairo, Ga.. and Meridian, Miss., and at State experiment stations conducting work at Baton Rouge, La., Poplarville, Miss., and Belle Glade, Fla. ☆

4. Seedlings of new varieties are grown in ordinary greenhouses such as this one at U. S. Sugar Plant Field Station, Houma, La. Plants are being inoculated with a disease to see if they have immunity or resistance.

New Syrup Sorgo

THOSE WHO CONSIDER SORGHUM SIRUP just the thing for pancakes may soon be using this product made from Wiley, a new sirup sorgo.

Developed under Federal-State cooperative breeding work at the U. S. Sugar Plant Field Laboratory, Meridian, Miss., the new variety rates higher than any other commercial sorgo in yield of high-quality sirup.

It was named in honor of the USDA chemist H. W. Wiley, who helped stimulate early research in sweet sorghums as a source of sugar.

Certified seed will be made available to growers next spring. Seed stocks are being increased in several southeastern States this year.

Field tests of Wiley have been made in comparison with Sart and Tracy, two other sirup sorgos in wide commercial use. Fully 40 tests have been conducted in the last 3 years under the direction of ARS agronomist I. E. Stokes at 27 experiment stations in 8 southeastern States, and at the Meridian and Cairo (Ga.) field stations.

Wiley proved immune to red rot and leaf anthracnose—diseases to which most of our present commercial sorgos are susceptible.

Classed as a late variety, Wiley matures 6 to 10 days earlier than Sart. Wiley proved well adapted to a wider range of environmental conditions without much effect on its maturity date. It's also less sensitive to time of planting than Sart. Good yields of high-quality sirup can be expected from Wiley planted any time from mid-April to late May.

Wiley grows 12 to 16 feet tall in good soil with adequate moisture. Stalks are bright green, largely because they're free of the external waxy bloom common to other commercial sorgos. The stalks have thin, hard rinds and yield more juice of higher sugar content than Sart.

Plants produce enough suckers to compensate for "skips" in a row, but not as profusely as Sart. Percentage rating for lodging is 3.6 for Wiley compared with 1.0 for Sart and 2.1 for Tracy—all low.

In the tests, Wiley produced 16.1 tons of stripped and topped stalks per acre—1.5 more than Sart, 3.4 more than Tracy. Wiley yielded 307 gallons of sirup per acre—48 more than Tracy, 30 more than Sart.

Juice of Wiley clarified rapidly and easily under all test conditions at all 29 locations. Sart and Tracy failed to boil down to proper density and didn't make acceptable sirup under adverse conditions.

ARS plant breeder O. H. Coleman and former pathologist F. J. LeBeau developed Wiley from crosses involving three parents. One was Collier, an early maturing sorgo with a high sugar content but highly susceptible to sorgo diseases of the Southeast. Another parent, MN 822, collected by botanist C. O. Grassl in the African Sudan, was found to be resistant to red rot and leaf anthracnose. These were crossed in 1947 at Meridian and the first generation was grown in 1948.

The same year, MN 2046, a late-maturing African variety collected by Grassl, was crossed with the first generation hybrid by using a special photoperiod technique. Seed from this cross were planted at the U. S. Sugar Plant Field Station, Canal Point, Fla., the following winter.

Coleman found one plant superior to all the others. This selection, Mer. 52–1, was advanced to tests and was subsequently named Wiley. ☆

Improved Paste Tomato

ROMA tomatoes from same plant vary some in shape and size. But all show typical elongated shape of the Italian paste-type tomato. Productive new Roma has been approved by growers and processors.

■ Roma, a new, highly wilt-resistant, red, paste-type tomato, has just been released for commercial use.

The new tomato was developed by USDA horticulturists at the Agricultural Research Center, Beltsville, Md. It is highly productive and the fruits show very good quality.

Roma tomatoes have heavy, fleshy outer and inner walls, usually $\frac{1}{4}$ to $\frac{3}{8}$ inch thick, and 2 or 3 small seed locules. The bright red pulp has a higher solids content than pulp of standard canning varieties. The tomatoes are suitable for processing whole, for manufacture of pulp, or for fortifying catsup and soup stocks.

The tomatoes grow in clusters of 3 to 5 fruits, with a range of 2 to 7 per cluster. The flesh is bright scarlet-red, and the skin is amber—a combination giving a brilliant scarlet external color under good cultural conditions. The fruit is an elongated oval shape, typical of Italian paste varieties, and measures about 2 to $2\frac{1}{2}$ inches by $1\frac{1}{4}$ to $1\frac{3}{4}$ inches.

Its parentage includes San Marzano, which is susceptible to fusarium wilt and blossom end rot; Red Top, susceptible to fusarium wilt; and Pan America, a standard type that is highly resistant to fusarium wilt.

San Marzano, one of our most popular red Italian paste-type tomatoes, was first crossed with Pan America. A wilt-resistant selection from the progeny was then crossed with Red Top. From the progency of the second cross, a productive line resistant to fusarium wilt was selected.

The new variety is a bush type of plant, generally similar in plant and fruit type to its Red Top parent. Although the Roma has a low spreading growth, it is more erect and carries its fruit higher than Red Top. The plant spread is usually about 3 to 4 feet; therefore, Roma may be set as close as 3 by 4 feet on land of average fertility. Plants usually have 8 to 10 lateral branches averaging approximately 2 feet in length. The leaves are medium-small but they are sufficiently abundant to furnish considerable shade to the growing Roma fruits until they begin to ripen. ☆

FRUITS MOVE FAST WHEN THEY'RE PRECOOLED

■ Experimental precooling of cherries, peaches, and other soft fruits by USDA on a commercial packing line made it possible to ship much of the pack on the same day it was picked.

The test precooler, costing only about $1,000, was both effective and versatile. It apparently is adapted for cooling three important soft fruits of the Pacific Northwest—cherries, apricots, and peaches. That means it could be used for 50 to 60 days during a season, which would seem to justify the cost of the installation.

The precooler was located in the cold storage room of the packing plant and used existing cooling facilities. It consists of a tapered duct 42 feet long placed above a fruit conveyor line, and a fan to blow the cold air (32° F.) from the cold storage room into the duct. In moving 16,000 cubic feet of air per minute, the fan built up sufficient pressure in the duct to discharge air at 3,200 feet per minute out through lengthwise slots in the bottom of the duct. Unlidded

boxes of fruit beneath were chilled to the proper temperature of 40° as they passed to the lidding station.

Boxed and lidded fruits stacked in cold storage require many hours to cool to 40°. Commercial experience showed that unlidded cherries can be cooled enough in 15 minutes under air blast without extra handling.

In the Yakima, Wash., plant where the work was done, the cherry packing rate was about 160 lugs per hour. That allowed each lug to spend 15 minutes beneath the air blast.

G. F. Sainsbury, agricultural engineer in charge of the study for the Agricultural Marketing Service, reports that this equipment and procedure were successful with cherries. Those fruits averaged 64° when they arrived from the field and were chilled down to about 40° during the 42-foot move through the air blast. It actually takes only about 12 minutes for the cherries to lose that much heat. Generally, those cherries were loaded into the refrigerator cars directly after lidding and were shipped on to the market without any delay.

The larger fruits studied, apricots and peaches, required a much longer exposure to the air blast. It took 25 to 30 minutes for apricots and 1 to 1½ hours for peaches. Having a double conveyor line under the duct would gain enough added time for apricots to cool down to 40°, but it's not practical to have the 300 feet of precooler line needed for peaches. Tests showed, however, that peaches packed 2 layers deep in lugs will lose half of their field heat in 34 to 37 minutes. That means that the double-line ordinarily would cool peaches to 55° and save time in cold storage.

Refrigeration retards both ripening and deterioration but isn't the entire answer. As Sainsbury points out, it pays to get soft fruit to market promptly after picking. The precooler now makes that possible. ☆

Carbohydrates ... Amino Acids ... and Liver Fat

■ THE KIND OF CARBOHYDRATE EATEN affects the body's need for amino acids (protein constituents) and its deposit of fat in the liver.

This is shown by studies at USDA's Agricultural Research Center, Beltsville, Md. On a low-amino-acid diet with sucrose (sugar) as the sole carbohydrate, laboratory rats accumulate excess fat in their livers. Moreover, the animals do not use amino acids efficiently and require more to supply their needs, as measured by their nitrogen balances. (Nitrogen is a constituent of every amino acid. When the body requires a greater amount of amino acids than the diet supplies, the body draws on its own reserves, releasing nitrogen. This nitrogen is excreted, causing greater excretion than intake, and the nitrogen balance becomes negative. See AGR. RES., July 1956, p. 12.)

When sucrose is replaced by other carbohydrates—corn dextrin, or rice, corn, or wheat starch—the animals' nutrition improves; they deposit less liver fat and make better use of amino acids. Feeding potato starch or glucose (a form of sugar) also results in less fat but no better nitrogen balances than when the sucrose is fed.

With extra threonine, one of the essential amino acids, there is less fat in the livers and nitrogen balances are less negative. Doubling the intake of all essential amino acids brings liver fat to normal or near-normal value and the nitrogen balances become positive.

ARS biochemist Madelyn Womack and nutritionist Mary W. Marshall first fed rats a diet containing all the nutrients known to be needed for good nutrition—except amino acids. The animals ate this nitrogen-free diet for 18 days while they used up some of the protein stored in their bodies. Then small amounts of amino acids were added to the rats' diets. Their nitrogen balance became a sensitive indicator of their need and use of amino acids as well as the effect of other factors.

During this period of amino-acid feeding, the carbohydrate or other test material was incorporated in the ration. After a 3-week period of experimental feeding, the animals were killed and their livers were quickly removed and analyzed for fat, protein, and moisture.

Much remains to be learned about how nearly human subjects resemble laboratory animals in the way they use nutrients. But the findings at Beltsville show the importance of interrelationships among nutrients. As further information is gained on these relationships, nutritionists and others will use it in evaluating the nutritional contributions of natural foods and in recommending diets for good health. ☆

En Garde

AGAINST ALIEN PLANT PESTS

Keeping insects and diseases out of the country is the big job ARS inspectors face

TRANSIENT field workers cross the border from Mexico to Texas cotton country with their few possessions in pick sacks—which also contain remains of seed cotton infested with the destructive pink bollworm, and mangoes and other fruit, hosts to the Mexican fruit fly. . . . A ship docking at Mobile has in its stores rice from India infested with the Khapra beetle, the world's worst stored-grain pest. . . . In the customs line on a New York pier the trunk of a passenger from Spain enroute to California yields a carton of fresh fruit containing larva of the Mediterranean fruit fly, a continuing threat to our vital citrus industry. . . . From England comes a shipment of small cars, their underparts caked with soil contaminated with cysts of the golden nematode, a tiny root pest highly destructive to potatoes and tomatoes. . . .

Multiply these incidents a thousandfold and you have some idea of how big and complex a job it is to keep plant-pest immigrants out of this country—the job that faces USDA's Plant Quarantine Branch.

Highly trained ARS inspectors are stationed at border, sea, and air ports to carry out provisions of the plant-quarantine laws designed to protect our food and plant resources. These inspectors check airplanes, steamships, trains, and automobiles, and examine cargo, stores, baggage, and mail for plant materials and foods that might contain dangerous plant-pest stowaways.

During the past year, plant-quarantine inspectors intercepted some 17,500 lots of destructive pests. . . . 11,600 insects and 5,900 diseases. . . . from throughout the world. In this same year they examined 54,700 vessels and 101,000 planes from overseas, as well as 17,000,000 motor vehicles, 101,000 freight cars, and 2,200 pullmans and coaches arriving from Mexico. Often unusual traffic loads must be met. For example, last year at one airport alone (Idlewild, N. Y.) members of the plant quarantine inspection staff cleared an average of 50 transatlantic planes daily during the peak month of July.

Inspectors must not only recognize insects and diseases in known plant sources but also be on the alert for the unexpected—even the unknown. They frequently discover new species of pests and detect pests from countries in which they were not previously reported.

Commercial imports of plants and plant materials are relatively simple for inspectors to control. Much of this material is certified by the country of origin as meeting sanitary growing and packing conditions. Nevertheless, inspectors examine such shipments to assure that they are free from pests and that no contaminating soil or prohibited packing material or commodities are present. Fumigation with gas or treatment with heat or cold, as a condition of entry, are other safeguards used for certain types of plant material and produce. Inspection and clearance of bulbs at the point of origin in Holland, Belgium, and France continues to prove an effective way of getting cleaner and healthier bulbs to our gardeners at less inspection cost to taxpayers.

Detecting unauthorized arrivals of plants and plant materials—those that may be brought in with the baggage or passengers or crew, or in shipments of gifts by mail or otherwise—often taxes the ingenuity of inspectors. Coming from gardens and farms of people all over the world, such material is usually grown and harvested with no suspicion that it may harbor harmful pests. Sometimes devious ways are used to get restricted material into this country without inspection. Customs inspectors cooperate with quarantine inspectors in helping to keep out such contraband plant materials and food.

Destructive plant pests could slip in with stores and furnishings of ships and planes. These are closely checked. Movement of military equipment and materials from overseas is subject to plant-quarantine inspection since it too may provide a means of plant-pest entry.

As fast transport shrinks distances between countries, and as foreign trade and travel expand, the danger of entry of destructive plant pests increases. Without the protection of plant-quarantine inspection, our country's losses from plant pests—now running over 3 billion dollars annually—would be substantially greater. ☆

1. Cargo of imported garlic is inspected by plant-quarantine inspectors. Some shipments may require treatment as a condition of entry, others may be denied entry because of presence of plant pests that can't be eliminated without damage to garlic.

2. Prohibited straw packing in a case of imported mineral water is found at Customs Appraiser's warehouse. Here, a plant-quarantine inspector can examine cross section of imported shipments and intercept plant materials that carry dangerous pests.

3. Foreign mail is watched for prohibited and restricted plant materials, with cooperation of Postal and Customs authorities. This bean seed is heavily infested with weevil. Packets of shamrocks and heather may contain cysts of golden nematode.

4. Passenger's baggage yields foreign-grown fruit during Customs inspection. Such contraband often carries fruit flies and other injurious insects and diseases. Baggage of passengers is the source of a great quantity of unauthorized plant material.

5. Fresh fruits and vegetables that arrive at our ports as stores of passenger and cargo planes from foreign countries are subject to plant-quarantine disposition to block the entry of plant pests into this country. Same is true for ships' stores.

6. Freight cars from Mexico that could introduce insect pests may be treated in big fumigation houses such as this one. Infested commodities, for either import or export, are treated commercially under supervision of plant-quarantine inspectors.

7. Nursery stock, seeds, cuttings are routed to a plant-inspection house for check and treatment. Above, plants are being put in chamber for methyl-bromide gas fumigation. Hot water, dry heat, and a chemical spray or dip are among treatments used.

8. Spraying inside planes that fly from Hawaiian Islands and Puerto Rico to mainland is precaution against insect stowaways. These include the oriental fruit fly, which may have entered Hawaii in military planes from Marianas in World War II.

9. Examinations, tests are made of imported plant material to detect and identify insects or diseases that may be present. Important findings are recorded since they will determine conditions for entry, may show need for future quarantine action.

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agrisearch notes

K. S. QUISENBERRY became Director of Crops Research July 1, succeeding A. H. Moseman, who resigned to become Rockefeller Foundation's associate director for agricultural programs.

Quisenberry has been Assistant Director of Crops Research and was assistant chief of the former Bureau of Plant Industry, Soils, and Agricultural Engineering. A native of Texas, he has been with USDA 31 years. He's widely known for his work on cereal crops. In the new position, he is in charge of the ARS Field Crops, Horticultural Crops, and Entomology Research Branches.

M. W. Parker, recently in charge of weed studies and former head of rubber crops work, became Assistant Director of Crops Research. He's a native of Maryland, has been in USDA 20 years.

A POINT SYSTEM with four food groups makes it easy to select a good diet. For use with a daily food plan developed by USDA nutrition analysts Louise Page and Esther F. Phipard, the system is described in "Essentials of an Adequate Diet," soon to be published.

The Daily Food Plan sets up four groups of food which help toward an adequate diet—milk, meat, vegetable-fruit, and cereal-bread. Each group, in the amount recommended, supplies a large part of the daily requirements for one or more key nutrients. Combined, they provide all or a major share of needed calcium, protein, iron, vitamins A and C, and B-vitamins. These foods also provide other vitamins and minerals as well as fats and carbohydrates important for health. Foods not emphasized in the daily plan usually appear in meals in combination with the specified foods and, nutritionwise, contribute chiefly calories.

The foods within each group are much alike in food value but they vary in amounts of nutrients provided. So that specific foods can be compared as sources of a key nutrient, they have been given point values. For example, 2 ounces of cooked lean meat, fish, or poultry score 10 points for protein; one egg, 4 points; and 2 ounces of luncheon meat, 6 points. At least 20 points daily from the meat (protein) group are suggested; for a day's meals this might include 1 egg (4 points), 2 ounces of beef (10 points), and ½ cup of baked beans (6 points).

This point system provides a way to check food choices rapidly to make sure that enough of each group is included in the diet each day. More of the foods in these groups as well as of other foods may be used to round out meals and satisfy appetite according to taste.

WEEDS ESTABLISHED and left throughout the growing season in a so-called clean-cultivated field may do more damage than you'd think, especially in wet seasons. A joint study of weeds in soybeans by the Iowa experiment station and USDA showed you'll get just a certain amount of above-ground vegetation in the row, and weed vegetation is wasteful of that productivity. At Ames, Iowa, the common weeds yellow foxtail (a grassy weed) and velvet leaf and Pennsylvania smartweed (broadleafs) were planted in the row with Hawkeye soybeans. Though 6 foxtail plants per foot of row cut yield only 2.6 percent, 12 weeds per foot cut yield 11.1 percent. Three of either broadleaf per foot of row cut yield 8 percent; 6 per foot cut yield 9.1 percent.

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